# MudWatt


Mid-Valley
STEM-CTE HUB

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# MudWatt:
## Grow a Living Fuel Cell

The MudWatt Kit offers an engaging, hands-on approach to STEM learning by allowing students to build a living fuel cell that generates clean energy from mud. This kit enables the exploration of microbiology, energy production, chemistry, physics, and environmental engineering. By harnessing the power of electricity-generating bacteria found in soil, learners can delve into concepts such as microbial fuel cells, renewable energy, and sustainability.

## Grade Level

**3rd - 8th grades**

## Group Size

**1 to 4 students per kit**

## Time Duration

- **Building your MudWatt:** 30–45 minutes
- **Measuring growth:** Once per day for 2 weeks

## Content of Kits

### Components

- Complete MudWatt Units:
- Anode
- Cathode
- Vessel
- BlinkerBoard
- Access to the MudWatt Explorer App (available on iTunes and Google Play)

### Consumables

- Soil (not included; recommended to be sourced locally)
- Gloves

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# Usage

## Getting Started

1. **Familiarize Yourself with Kit Components:** Look through the kit to make sure all components are identified, available and, organized.

2. **Gather Soil:** Collect soil from various environments (e.g., garden, park) to experiment with different microbial communities.

3. **Assemble the MudWatt:** Follow the instructional booklet to layer the soil, place the electrodes (anode and cathode), and set up the BlinkerBoard.

4. **Monitor Growth:** Use the MudWatt Explorer App to track microbial activity and power generation over time.

5. **Experiment:** Test different soil types or add organic materials (like food scraps) to observe variations in energy output.

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## Storage

After completing experiments, clean the MudWatt components by rinsing the electrodes and container. Ensure the electrodes are dry and stored properly to avoid any degradation. Optionally, sanitize the electrodes with ethanol or rubbing alcohol to reset for future use

## Troubleshooting

- **Power Output:**
  - If the LED isn't blinking after a week, ensure the cathode is exposed to air and not submerged.
  - Verify that the soil is moist but not waterlogged.
  - Check all connections and consider trying a different soil sample.
- **App Connectivity:**
  - Ensure the device's Bluetooth is enabled and the app is updated to the latest version.

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# Activity Guide

## Beginner

**Basic Mud Fuel Cell**
Students can start by assembling a basic MudWatt fuel cell, layering soil into the provided vessel and placing the anode and cathode correctly. This initial step introduces them to the concept of microbial fuel cells, where bacteria naturally present in soil generate electricity. Once the setup is complete, students can observe how long it takes for the LED to blink, providing a visual indicator of microbial activity and energy production.

## Intermediate

**Soil Comparison Experiment**
Students can test different soil samples to determine which type generates the most power. By analyzing factors such as moisture content, organic material, and microbial diversity, students gain insight into how environmental conditions affect energy production. They will record data over time, graphing power output and drawing conclusions about which variables contribute to increased efficiency.

## Advanced

**Renewable Energy Microgrid**
Students will design a microbial fuel cell network using multiple MudWatt kits to create a small-scale renewable energy microgrid. By connecting several MudWatt cells in series and parallel, they will experiment with maximizing power output. Additionally, students will explore real-world applications by discussing how microbial fuel cells could provide sustainable power in remote or off-grid locations. This project encourages advanced problem-solving, engineering thinking, and innovation in renewable energy technologies.

## Extension Activities:

**MudWatt-Powered Environmental Sensor**
Building on their knowledge of microbial fuel cells, students will integrate their MudWatt system with a low-power environmental sensor, such as a soil moisture or temperature sensor. They will use the electricity generated by the MudWatt to power the sensor and collect real-time environmental data. Students will analyze their findings, discuss how microbial fuel cells could support long-term environmental monitoring, and explore real-world applications in agriculture and conservation. This activity reinforces STEAM concepts by combining renewable energy, data collection, and sustainability.

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# Learning Extensions

## STEAM Connections: Electrical Engineering - Microbiology

## Learning Objectives:

**The MudWatt Kit encourages creativity, critical thinking, and scientific inquiry through interactive, project-based activities.**

- Understand the principles of microbial fuel cells and renewable energy.
- Explore the role of microbes in energy production and environmental sustainability.
- Develop skills in scientific experimentation, data collection, and analysis.
- Foster problem-solving and critical thinking through hands-on learning.

## Career Connections:

- **Environmental Engineer:** Designing solutions for sustainable energy and waste management.
- **Microbiologist:** Studying microorganisms and their applications in energy and health.
- **Renewable Energy Scientist:** Developing new technologies for clean energy production.
- **Biochemical Engineer:** Applying principles of biology and chemistry to create products and processes.

## Essential Employability Skills:

- Critical thinking
- Problem-solving
- Creativity
- Teamwork
- Communication

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# Resources and Accessibility

## Safety Guidelines

- **Supervise** all activities involving soil and microbial growth.
- **Use gloves** when handling soil to prevent exposure to potential pathogens.
- Ensure that students **wash their hands** thoroughly after the experiment.
- Keep small components out of reach of young children to prevent **choking hazards.**
- Follow **proper hygiene and sanitation** practices when cleaning and storing the kit.

## Accessibility

- Ensure workspaces are inclusive and accommodate all students, including those with physical disabilities.

- Provide alternative methods for data collection and analysis, such as verbal reporting or assistive technology.

## Library Catalog

## Library Resources

## Feedback

QR to feedback survey